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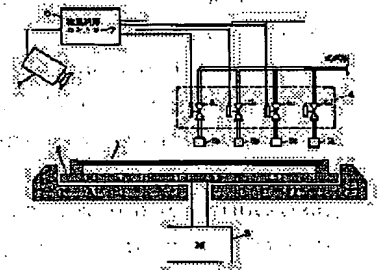
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(54) SINGLE SUBSTRATE PROCESSING DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To supply a processing liquid properly and uniformly adjust the surface temperature of a substrate.

SOLUTION: Four nozzles 5a-5d are arranged at positions which are differently distant respectively, toward the outer periphery from the rotary center of a substrate 1. A radiation thermometer 7 constantly detects the surface temperature distribution of the substrate 1 and the detection results are output to a flow rate controller 6. The radiation thermometer 7 indicates the surface temperature of the rapidly rotating substrate 1 as a concentric temperature distribution. The flow rate controller 6 analyzes the detected results of the temperature distribution received from the radiation thermometer 7, and controls the flow rate of a processing liquid by adjusting the individual opening levels of valves 4a-4d on a processing liquid supply device 4 so that the surface temperature of the substrate 1 is uniform.



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CLAIMS

[Claim(s)]

[Claim 1] A substrate rotation means to be the single-wafer-processing substrate processor which supplies processing liquid to the front face of the rotating substrate, and to rotate said substrate, Two or more nozzles which are located in distance which is different toward the direction of a periphery, respectively from the center of rotation of said substrate, and supply said processing liquid on the substrate concerned, Two or more flow regulation means which carry out adjustable [of the flow rate of said processing liquid which corresponds to each of two or more of said nozzles, and two or more nozzles concerned supply]. A single-wafer-processing substrate processor equipped with a temperature detection means to detect distribution of the skin temperature of said whole substrate, and the flow rate control means which controls said two or more flow regulation means according to an individual based on the contents of detection of said temperature detection means so that distribution of the skin temperature of said substrate becomes uniform.

[Claim 2] A substrate rotation means to be the single-wafer-processing substrate processor which supplies the processing liquid of M (M is two or more integers) class with which only temperature differs to the front face of the rotating substrate, and to rotate said substrate, The nozzle of N (N is two or more integers) individual which is located in distance which is different toward the direction of a periphery, respectively from the center of rotation of said substrate, and supplies said M kinds of processing liquid on the substrate concerned, The flow regulation means of the individual which carries out adjustable [of the flow rate of M kinds of said processing liquid which corresponds to each of the nozzle of said N individual, and the nozzle of the N individual concerned supplies] (MxN), A single-wafer-processing substrate processor equipped with a temperature detection means to detect distribution of the skin temperature of said whole substrate, and the flow rate control means which controls the flow regulation means of the aforementioned (MxN) individual according to an individual based on the contents of detection of said temperature detection means so that distribution of the skin temperature of said substrate becomes uniform.

[Claim 3] Said flow rate control means is a single-wafer-processing substrate processor according to claim 2 characterized by controlling the flow regulation means of the aforementioned (MxN) individual so that the processing liquid with which flow rates differ at the same temperature from the nozzle of said N individual is supplied.

[Claim 4] Said flow rate control means is a single-wafer-processing substrate processor according to claim 2 characterized by controlling the flow regulation means of the aforementioned (MxN) individual so that the processing liquid of temperature which is different by the same flow rate from the nozzle of said N individual is supplied.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] More specifically, this invention relates to the single-wafer-processing substrate processor which supplies processing liquid (a drug solution, pure water, etc.), and processes arbitration on the surface of substrates (a semi-conductor wafer, the glass substrate for liquid crystal displays, the glass substrate for photo masks, substrate for optical disks, etc.) about a single-wafer-processing substrate processor.

[0002]

[Description of the Prior Art] From the former, a single-wafer-processing substrate processor exists as equipment which performs surface preparation (etching, washing, photoresist spreading, development, etc.) of a substrate using processing liquid. This single-wafer-processing substrate processor is equipment which supplies processing liquid to the rotating substrate and performs surface treatment.

[0003] Drawing 4 is drawing of longitudinal section of the conventional single-wafer-processing substrate processor. In drawing 4, the conventional single-wafer-processing substrate processor is equipped with the spin base 2 which holds a substrate 1 fixed, the motor 3 which carries out high-speed rotation of the spin base 2, and the processing liquid feeder 4 which supplies processing liquid to a part for the surface core of a substrate 1 from nozzle 5a. The processing liquid feeder 4 opens and closes bulb 4a, and supplies processing liquid.

[0004] The conventional single-wafer-processing substrate processor is supplying processing liquid to a part for the core of the substrate 1 which carries out high-speed rotation from nozzle 5a, and supplying the processing liquid from a part for a core to the periphery part of a substrate 1 by the above-mentioned configuration, using the centrifugal force of a substrate 1, and makes surface treatment of the substrate 1 whole possible.

[0005]

[Problem(s) to be Solved by the Invention] Here, in order that the processing liquid used for the surface treatment of a substrate 1 may pull out the treatment effect to the maximum extent, what was adjusted to the temperature defined beforehand is used.

[0006] however — in order to only supply processing liquid to one place for a core of a substrate 1, until it supplies processing liquid to the periphery part of a substrate 1 in the above-mentioned conventional single-wafer-processing substrate processor using a centrifugal force — processing liquid — heat dissipation — or endoergic is carried out and whenever [processing solution temperature / of the substrate 1 whole] does not become homogeneity. That is, the temperature of the processing liquid for a core of a substrate 1 will differ from the temperature of the processing liquid of a periphery part.

[0007] Thus, when the temperature of the processing liquid of the substrate 1 whole does not become homogeneity, removal of the organic-substance metallurgy group and the particle held using hot processing liquid etc. lacks in the homogeneity of processing, and the problem that where of the progress condition of etching becomes an ununiformity in a part for a core and the periphery part of a substrate 1 produces it by that processing liquid is expensive than ordinary temperature or it being low in etching performed using the processing liquid before and behind ordinary temperature.

[0008] So, the purpose of this invention is offering the single-wafer-processing substrate processor which supplies processing liquid appropriately and adjusts the skin temperature of a substrate to homogeneity.

[0009]

[The means for solving a technical problem and an effect of the invention] A substrate rotation means for the 1st invention to be a single-wafer-processing substrate processor which supplies processing liquid to the front face of the rotating substrate, and to rotate a substrate. Two or more nozzles which are located in distance which is different toward the direction of a periphery, respectively from the center of rotation of a substrate, and supply processing liquid on the substrate concerned. Two or more flow regulation means which carry out adjustable [of the flow rate of the processing liquid which corresponds to each of two or more nozzles, and two or more nozzles concerned supply], It has a temperature detection means to detect distribution of the skin temperature of the whole substrate, and the flow rate control means which controls two or more flow regulation means according to an individual based on the contents of detection of a temperature detection means so that distribution of the skin temperature of a substrate becomes uniform.

[0010] As mentioned above, according to the 1st invention, skin temperature of a substrate can be made into

homogeneity by operating two or more flow regulation means corresponding to the temperature distribution always detected with a temperature detection means, and carrying out increase and decrease of the amount of supply of the processing liquid from two or more nozzles of control appropriately. Therefore, the homogeneity of the surface treatment of a substrate improves.

[0011] A substrate rotation means for the 2nd invention to be a single-wafer-processing substrate processor which supplies the processing liquid of M (M is two or more integers) class with which only temperature differs to the front face of the rotating substrate, and to rotate a substrate, The nozzle of N (N is two or more integers) individual which is located in distance which is different toward the direction of a periphery, respectively from the center of rotation of a substrate, and supplies M kinds of processing liquid on the substrate concerned, The flow regulation means of the individual which carries out adjustable [of the flow rate of M kinds of processing liquid which corresponds to each of the nozzle of N individual and the nozzle of the N individual concerned supplies] (MxN), It has a temperature detection means to detect distribution of the skin temperature of the whole substrate, and the flow rate control means which controls the flow regulation means of an individual according to an individual based on the contents of detection of a temperature detection means so that distribution of the skin temperature of a substrate becomes uniform (MxN).

[0012] As mentioned above, according to the 2nd invention, it has the flow regulation means of N individual for M kinds from which only the temperature to supply differs of every processing liquid. And skin temperature of a substrate can be made into homogeneity by operating the flow regulation means of an individual (MxN) corresponding to the temperature distribution always detected with a temperature detection means, and carrying out increase and decrease of the amount of supply of the processing liquid from the nozzle of N individual of control appropriately. Therefore, the homogeneity of the surface treatment of a substrate improves.

[0013] 3rd invention is characterized by a flow rate control means controlling the flow regulation means of an individual so that the processing liquid with which flow rates differ at the same temperature from the nozzle of N individual is supplied (MxN) in the 2nd invention.

[0014] The 3rd invention considers the control approach of the flow rate control means in the 2nd invention as control by the flow rate of processing liquid.

[0015] 4th invention is characterized by a flow rate control means controlling the flow regulation means of an individual so that the processing liquid of temperature which is different by the same flow rate from the nozzle of N individual is supplied (MxN) in the 2nd invention.

[0016] The 4th invention considers the control approach of the flow rate control means in the 2nd invention as control by the temperature of processing liquid.

[0017]

[Embodiment of the Invention] (1st operation gestalt) Drawing 1 is drawing of longitudinal section of the single-wafer-processing substrate processor concerning the 1st operation gestalt of this invention. In drawing 1, the single-wafer-processing substrate processor of the operation gestalt of **** 1 is equipped with the spin base 2 which holds a substrate 1 free [rotation], the motor 3 which carries out high-speed rotation of the spin base 2, the processing liquid feeder 4 which supplies processing liquid to the front face of a substrate 1 from four nozzles 5a-5d, the control-of-flow controller 6 which controls the flow rate of the processing liquid of the processing liquid feeder 4, and the radiation thermometer 7 which detect the temperature distribution of substrate 1 front face. The processing liquid feeder 4 is equipped with four bulbs 4a-4d.

[0018] Four nozzles 5a-5d are formed in the location in distance which is different toward the direction of a periphery, respectively from the center of rotation of a substrate 1. The radiation thermometer 7 has always detected the temperature distribution of substrate 1 front face, and outputs the result of the temperature distribution to the control-of-flow controller 6. Here, a radiation thermometer 7 will regard the skin temperature of the substrate 1 which carries out high-speed rotation as concentric circle-like temperature distribution. The control-of-flow controller 6 adjusts bulbs [of the processing liquid feeder 4 / 4a-4d] opening level separately, and controls the flow rate of processing liquid so that the temperature-distribution result received from the radiation thermometer 7 is analyzed and the skin temperature of a substrate 1 becomes homogeneity.

[0019] Control performed by the control-of-flow controller 6 is performed by [as being the following]. When it must process in the range whose skin temperature of a substrate 1 is 78 degrees C - 80 degrees C using 80-degree C processing liquid, When from a part for a core to the periphery part of a substrate 1 serves as temperature distribution of the shape of a concentric circle which is 80 degrees C - 70 degrees C as a result of the first processing liquid supply (see drawing 2) processing — liquid — a flow rate — " — a nozzle — five — d

— it is — a flow rate — > — a nozzle — five — c — a flow rate — > — a nozzle — five — b — a flow rate —
 > — a nozzle — five — a — a flow rate — " — becoming — as — Bulbs [4a-4d] opening level — respectively
 — an individual exception — controlling . That is, it is that which increases the amount of supply of the
 processing liquid to a periphery part with low temperature, and reduces the amount of supply of the processing
 liquid for a core (or now is still sufficient as the amount of supply for a core).

[0020] As mentioned above, the single-wafer-processing substrate processor of the operation gestalt of **** 1
 can change the each bulbs [4a-4d] amount of openings corresponding to the always detected temperature
 distribution, and can make skin temperature of a substrate 1 homogeneity by carrying out increase and decrease
 of the amount of supply of the processing liquid from each nozzles 5a-5d of control appropriately. In addition,
 control of Bulbs 4a-4d can also be carried out fixed by the ratio simply obtained from analysis or an actual proof
 besides the approach of making follow the temperature distribution detected as mentioned above, and tuning
 opening level finely according to an individual.

[0021] (2nd operation gestalt) Drawing 3 is drawing of longitudinal section of the single-wafer-processing
 substrate processor concerning the 2nd operation gestalt of this invention. In drawing 3 the single-wafer-
 processing substrate processor of the operation gestalt of **** 2 The spin base 2 held for a substrate 1, enabling
 free rotation, and the motor 3 which carries out high-speed rotation of the spin base 2, It has the processing
 liquid feeder 4 which supplies the 1st and 2nd processing liquid to the front face of a substrate 1 from four
 nozzles 5a-5d, the control-of-flow controller 6 which controls the flow rate of the 1st of the processing liquid
 feeder 4, and the 2nd processing liquid, and the radiation thermometer 7 which detects the temperature
 distribution of substrate 1 front face. The processing liquid feeder 4 is equipped with eight bulbs 4a-4h.

[0022] The single-wafer-processing substrate processor of the operation gestalt of **** 2 has two processing
 liquid supply networks in the processing liquid feeder 4 compared with the single-wafer-processing substrate
 processor of the operation gestalt of the above 1st so that drawing 3 may also show (a Bulbs [4a-4d] network
 and Bulbs [4e-4h] network). And in this processing liquid feeder 4, although it is of the same kind, the 1st and
 2nd processing liquid with which temperature differs is supplied to Bulbs 4a-4d and Bulbs 4e-4h, respectively.

[0023] Here, when the temperature of the 1st processing liquid is [the temperature of the 2nd processing liquid]
 90 degrees C at 80 degrees C, control performed by the control-of-flow controller 6 is performed by [as being
 the following]. When it must process in the range whose skin temperature of a substrate 1 is 78 degrees C - 80
 degrees C, When from a part for a core to the periphery part of a substrate 1 serves as temperature distribution
 of the shape of a concentric circle which is 80 degrees C - 70 degrees C as a result of the first processing liquid
 supply (see drawing 2) Closing motion of Bulbs 4a-4h is controlled according to an individual, respectively to
 supply the 2nd processing liquid to nozzle 5c and nozzle 5d, and to supply the 1st processing liquid to nozzle 5a
 and nozzle 5b (Bulbs 4c, 4d, 4e, and 4f are stopped, and opening of the bulbs 4a, 4b, 4g, and 4h is carried out). At
 this time, Bulbs [4a-4h] opening level may be controlled according to an individual, respectively to become "the
 flow rate of flow rate > nozzle 5a of flow rate > nozzle 5b of nozzle 5d flow rate > nozzle 5c" at coincidence.

Moreover, it is also possible by changing the rate of a throat area ratio (bulb 4a, bulb 4e and bulb 4b, bulb 4f and
 bulb 4c, bulb 4g or bulb 4d, and bulb 4h) to mix and supply the 1st processing liquid and the 2nd processing liquid.

[0024] As mentioned above, the single-wafer-processing substrate processor of the operation gestalt of **** 2
 can make skin temperature of a substrate 1 homogeneity early more compared with the single-wafer-processing
 substrate processor of the operation gestalt of the above 1st by using the temperature control of processing
 liquid, control of flow, or its both sides by having a processing liquid feed zone to the processing liquid with which
 temperature differs, respectively. In addition, the processing liquid of a different class can also be used for two
 processing liquid feed zones in the processing liquid feeder 4.

[0025] In addition, in the single-wafer-processing substrate processor of the above 1st and the 2nd operation
 gestalt, although explained using four bulbs 4a-4d (and bulbs 4e-4h), the number of bulbs is not restricted to this,
 but can set up the number freely. Moreover, although the single-wafer-processing substrate processor of the
 operation gestalt of the above 2nd explained the case where it had two processing liquid feed zones, the number
 of networks of a processing liquid feed zone is not restricted to this, either, but the number can be set up freely.
 furthermore — although four nozzles 5a-5d were formed to eight bulbs 4a-4h in the single-wafer-processing
 substrate processor of the operation gestalt of the above 2nd — eight bulbs 4 — a nozzle may be prepared every
 a-4h, respectively. Moreover, with the above 1st and the 2nd operation gestalt, although the flow rate was
 controlled by Bulbs 4a-4h, it may replace with a bulb, a flow rate may be controlled using a regulator, and a means
 to adjust a flow rate is not limited to a bulb.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is drawing of longitudinal section of the single-wafer-processing substrate processor concerning the 1st operation gestalt of this invention.

[Drawing 2] It is drawing showing an example of the temperature distribution of substrate 1 front face.

[Drawing 3] It is drawing of longitudinal section of the single-wafer-processing substrate processor concerning the 2nd operation gestalt of this invention.

[Drawing 4] It is drawing of longitudinal section of the conventional single-wafer-processing substrate processor.

[Description of Notations]

1 — Substrate

2 — Spin base

3 — Motor

4 — Processing liquid feeder

4a-4h — Bulb

5a-5d — Nozzle

6 — Control-of-flow controller

7 — Radiation thermometer

[Translation done.]

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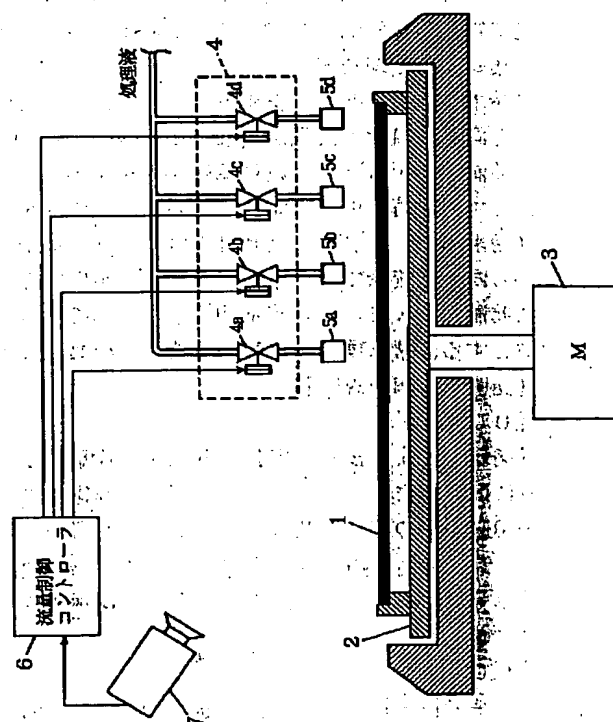
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(54) 【発明の名称】 枚葉式基板処理装置

(57) 【要約】

【課題】 処理液を適切に供給し、基板の表面温度を均一に調整する枚葉式基板処理装置を提供する。

【解決手段】 4つのノズル5a～5dは、基板1の回転中心から外周方向へ向かって、それぞれ異なる距離にある位置に設けられている。放射温度計7は、常時基板1表面の温度分布を検出しており、その温度分布の結果を流量制御コントローラ6へ出力する。ここで、放射温度計7は、高速回転する基板1の表面温度を同心円状の温度分布としてとらえることになる。流量制御コントローラ6は、放射温度計7から受けた温度分布結果を解析し、基板1の表面温度が均一になるように、処理液供給装置4のバルブ4a～4dの開口レベルを個々に調整して処理液の流量を制御する。



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【特許請求の範囲】

【請求項1】 回転する基板の表面に処理液を供給する枚葉式基板処理装置であって、
前記基板を回転させる基板回転手段と、
前記基板の回転中心から外周方向へ向かいそれぞれ異なる距離に位置し、前記処理液を当該基板上に供給する複数のノズルと、
前記複数のノズルのそれぞれに対応し、当該複数のノズルが供給する前記処理液の流量を可変する複数の流量調節手段と、
前記基板全体の表面温度の分布を検出する温度検出手段と、
前記温度検出手段の検出内容に基づいて、前記基板の表面温度の分布が均一となるように前記複数の流量調節手段を個別に制御する流量制御手段とを備える、枚葉式基板処理装置。

【請求項2】 回転する基板の表面に温度のみ異なるM（Mは2以上の整数）種類の処理液を供給する枚葉式基板処理装置であって、
前記基板を回転させる基板回転手段と、
前記基板の回転中心から外周方向へ向かいそれぞれ異なる距離に位置し、前記M種類の処理液を当該基板上に供給するN（Nは2以上の整数）個のノズルと、
前記N個のノズルのそれぞれに対応し、当該N個のノズルが供給する前記M種類の処理液の流量を可変する（ $M \times N$ ）個の流量調節手段と、
前記基板全体の表面温度の分布を検出する温度検出手段と、
前記温度検出手段の検出内容に基づいて、前記基板の表面温度の分布が均一となるように前記（ $M \times N$ ）個の流量調節手段を個別に制御する流量制御手段とを備える、枚葉式基板処理装置。

【請求項3】 前記流量制御手段は、前記N個のノズルから同一の温度で流量が異なる処理液が供給されるように前記（ $M \times N$ ）個の流量調節手段を制御することを特徴とする、請求項2に記載の枚葉式基板処理装置。

【請求項4】 前記流量制御手段は、前記N個のノズルから同一の流量で異なる温度の処理液が供給されるように前記（ $M \times N$ ）個の流量調節手段を制御することを特徴とする、請求項2に記載の枚葉式基板処理装置。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、枚葉式基板処理装置に関し、より特定的には、基板（半導体ウエハ、液晶表示装置用のガラス基板、フォトマスク用のガラス基板、光ディスク用の基板等）の表面に、処理液（薬液、純水等）を供給して任意の処理を行う枚葉式基板処理装置に関する。

【0002】

【従来の技術】従来から、処理液を用いて基板の表面処

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理（エッチング、洗浄、フォトリソグ、現像等）を行う装置として、枚葉式基板処理装置が存在する。この枚葉式基板処理装置とは、回転する基板に処理液を供給して、表面処理を行う装置である。

【0003】図4は、従来の枚葉式基板処理装置の縦断面図である。図4において、従来の枚葉式基板処理装置は、基板1を固定的に保持するスピンドル2と、スピンドル2を高速回転させるモータ3と、基板1の表面中心部分にノズル5aから処理液を供給する処理液供給装置4とを備える。処理液供給装置4は、バルブ4aを開閉して処理液を供給する。

【0004】従来の枚葉式基板処理装置は、上記構成により、高速回転する基板1の中心部分にノズル5aから処理液を供給し、基板1の遠心力を利用して基板1の中心部分から外周部分への処理液の供給を行うことで、基板1全体の表面処理を可能としている。

【0005】

【発明が解決しようとする課題】ここで、基板1の表面処理に使用する処理液は、その処理効果を最大限に引き出すために予め定めた温度に調整したものが用いられる。

【0006】しかし、上記従来の枚葉式基板処理装置においては、基板1の中心部分の1箇所に処理液を供給するだけであるため、処理液を遠心力を利用して基板1の外周部分へ供給するまでに処理液が放熱または吸熱してしまい、基板1全体の処理液温度が均一にならない。すなわち、基板1の中心部分の処理液の温度と外周部分の処理液の温度とが異なってしまうのである。

【0007】このように、基板1全体の処理液の温度が均一にならない場合、例えば、高温の処理液を用いて行う有機物や金属およびパーティクルの除去等は、処理の均一性に欠け、常温前後の処理液を用いて行うエッチングにおいては、処理液が常温より高いか低いかによって、基板1の中心部分と外周部分とでエッチングの進み具合が不均一になるという問題が生じる。

【0008】それ故、本発明の目的は、処理液を適切に供給し、基板の表面温度を均一に調整する枚葉式基板処理装置を提供することである。

【0009】

【課題を解決するための手段および発明の効果】第1の発明は、回転する基板の表面に処理液を供給する枚葉式基板処理装置であって、基板を回転させる基板回転手段と、基板の回転中心から外周方向へ向かいそれぞれ異なる距離に位置し、処理液を当該基板上に供給する複数のノズルと、複数のノズルのそれぞれに対応し、当該複数のノズルが供給する処理液の流量を可変する複数の流量調節手段と、基板全体の表面温度の分布を検出する温度検出手段と、温度検出手段の検出内容に基づいて、基板の表面温度の分布が均一となるように複数の流量調節手段を個別に制御する流量制御手段とを備える。

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【0010】上記のように、第1の発明によれば、温度検出手段で常時検出する温度分布に対応して複数の流量調節手段を操作して、複数のノズルからの処理液の供給量を適切に増減制御してやることで、基板の表面温度を均一にすることができる。従って、基板の表面処理の均一性が向上する。

【0011】第2の発明は、回転する基板の表面に温度のみ異なるM（Mは2以上の整数）種類の処理液を供給する枚葉式基板処理装置であって、基板を回転させる基板回転手段と、基板の回転中心から外周方向へ向かいそれぞれ異なる距離に位置し、M種類の処理液を当該基板上に供給するN（Nは2以上の整数）個のノズルと、N個のノズルのそれぞれに対応し、当該N個のノズルが供給するM種類の処理液の流量を可変する（ $M \times N$ ）個の流量調節手段と、基板全体の表面温度の分布を検出する温度検出手段と、温度検出手段の検出内容に基づいて、基板の表面温度の分布が均一となるように（ $M \times N$ ）個の流量調節手段を個別に制御する流量制御手段とを備える。

【0012】上記のように、第2の発明によれば、供給する温度のみ異なるM種類の処理液ごとにN個の流量調節手段を備えている。そして、温度検出手段で常時検出する温度分布に対応して（ $M \times N$ ）個の流量調節手段を操作して、N個のノズルからの処理液の供給量を適切に増減制御してやることで、基板の表面温度を均一にすることができる。従って、基板の表面処理の均一性が向上する。

【0013】第3の発明は、第2の発明において、流量制御手段は、N個のノズルから同一の温度で流量が異なる処理液が供給されるように（ $M \times N$ ）個の流量調節手段を制御することを特徴とする。

【0014】第3の発明は、第2の発明における流量制御手段の制御方法を、処理液の流量による制御としたものである。

【0015】第4の発明は、第2の発明において、流量制御手段は、N個のノズルから同一の流量で異なる温度の処理液が供給されるように（ $M \times N$ ）個の流量調節手段を制御することを特徴とする。

【0016】第4の発明は、第2の発明における流量制御手段の制御方法を、処理液の温度による制御としたものである。

【0017】

【発明の実施の形態】（第1の実施形態）図1は、本発明の第1の実施形態に係る枚葉式基板処理装置の縦断面図である。図1において、本第1の実施形態の枚葉式基板処理装置は、基板1を回転自在に保持するスピンドル2と、スピンドル2を高速回転させるモータ3と、基板1の表面に4つのノズル5a～5dから処理液を供給する処理液供給装置4と、処理液供給装置4の処理液の流量を制御する流量制御コントローラ6と、基板1表

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面の温度分布を検出する放射温度計7とを備える。処理液供給装置4は、4つのバルブ4a～4dを備える。

【0018】4つのノズル5a～5dは、基板1の回転中心から外周方向へ向かって、それぞれ異なる距離にある位置に設けられている。放射温度計7は、常時基板1表面の温度分布を検出しており、その温度分布の結果を流量制御コントローラ6へ出力する。ここで、放射温度計7は、高速回転する基板1の表面温度を同心円状の温度分布としてとらえることになる。流量制御コントローラ6は、放射温度計7から受けた温度分布結果を解析し、基板1の表面温度が均一になるように、処理液供給装置4のバルブ4a～4dの開ロレベルを個々に調整して処理液の流量を制御する。

【0019】流量制御コントローラ6で行う制御は、例えば、以下の様にして行う。80℃の処理液を用いて、基板1の表面温度が78℃～80℃の範囲において処理を行わなければならないとき、最初の処理液供給の結果、基板1の中心部分から外周部分までが80℃～70℃の同心円状の温度分布となっている場合（図2を参照）には、処理液の流量が「ノズル5dの流量>ノズル5cの流量>ノズル5bの流量>ノズル5aの流量」となるようにバルブ4a～4dの開ロレベルをそれぞれ個別に制御する。すなわち、温度の低い外周部分への処理液の供給量を増やし、中心部分への処理液の供給量を減らす（または、中心部分の供給量は今のままでもよい）のである。

【0020】以上のように、本第1の実施形態の枚葉式基板処理装置は、常時検出する温度分布に対応して各バルブ4a～4dの開ロ量を変化させ、各ノズル5a～5dからの処理液の供給量を適切に増減制御してやることで、基板1の表面温度を均一にすることができる。なお、バルブ4a～4dの制御は、上記のように検出した温度分布に追従させて開ロレベルを個別に微調整する方法のほか、単純に解析や実証から得た比率で固定的に行うことも可能である。

【0021】（第2の実施形態）図3は、本発明の第2の実施形態に係る枚葉式基板処理装置の縦断面図である。図3において、本第2の実施形態の枚葉式基板処理装置は、基板1を回転自在に保持するスピンドル2と、スピンドル2を高速回転させるモータ3と、基板1の表面に4つのノズル5a～5dから第1および第2の処理液を供給する処理液供給装置4と、処理液供給装置4の第1および第2の処理液の流量を制御する流量制御コントローラ6と、基板1表面の温度分布を検出する放射温度計7とを備える。処理液供給装置4は、8つのバルブ4a～4hを備える。

【0022】図3からも分かるように、本第2の実施形態の枚葉式基板処理装置は、上記第1の実施形態の枚葉式基板処理装置に比べ、処理液供給装置4内に処理液供給系統を2つ有している（バルブ4a～4dの系統とバ

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ルブ4e～4hの系統)。そして、この処理液供給装置4において、バルブ4a～4dおよびバルブ4e～4hには、同種類であるが温度が異なる第1および第2の処理液がそれぞれ供給される。

【0023】ここで、第1の処理液の温度が80℃で第2の処理液の温度が90℃である場合、流量制御コントローラ6で行う制御は、例えば、以下の様に行う。基板1の表面温度が78℃～80℃の範囲において処理を行わなければならないとき、最初の処理液供給の結果、基板1の中心部分から外周部分までが80℃～70℃の同心円状の温度分布となっている場合（図2を参照）には、ノズル5cおよびノズル5dに第2の処理液を供給し、ノズル5aおよびノズル5bには第1の処理液を供給するようにバルブ4a～4hの開閉をそれぞれ個別に制御する（バルブ4c、4d、4e、4fを閉止し、バルブ4a、4b、4g、4hを開口する）。このとき、同時に「ノズル5dの流量>ノズル5cの流量>ノズル5bの流量>ノズル5aの流量」となるようにバルブ4a～4hの開口レベルをそれぞれ個別に制御してもよい。また、バルブ4aとバルブ4e、バルブ4bとバルブ4f、バルブ4cとバルブ4gまたはバルブ4dとバルブ4hの開口比率を変化させることにより、第1の処理液と第2の処理液とを混合して供給することも可能である。

【0024】以上のように、本第2の実施形態の枚葉式基板処理装置は、温度の異なる処理液に対しそれぞれ処理液供給部を有することにより、処理液の温度制御または流量制御若しくはその双方を用いることで、上記第1の実施形態の枚葉式基板処理装置に比べ、より早く基板1の表面温度を均一にすることができる。なお、処理液供給装置4内の2系統の処理液供給部には、異なる種類の処理液を用いることもできる。

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【0025】なお、上記第1および第2の実施形態の枚葉式基板処理装置では、4つのバルブ4a～4d（およびバルブ4e～4h）を用いて説明したが、バルブの数はこれに限られず自由にその数を設定することができる。また、上記第2の実施形態の枚葉式基板処理装置では、2系統の処理液供給部を有する場合を説明したが、処理液供給部の系統数もこれに限られず自由にその数を設定することができる。さらに、上記第2の実施形態の枚葉式基板処理装置では、8つのバルブ4a～4hに対して4つのノズル5a～5dを設けたが、8つのバルブ4a～4hごとにそれぞれノズルを設けてもよい。また、上記第1および第2の実施形態では、バルブ4a～4hで流量を制御したが、バルブに代えてレギュレータを使用して流量を制御してもよく、流量を調節する手段はバルブに限定されるものではない。

【図面の簡単な説明】

【図1】本発明の第1の実施形態に係る枚葉式基板処理装置の縦断面図である。

【図2】基板1表面の温度分布の一例を示す図である。

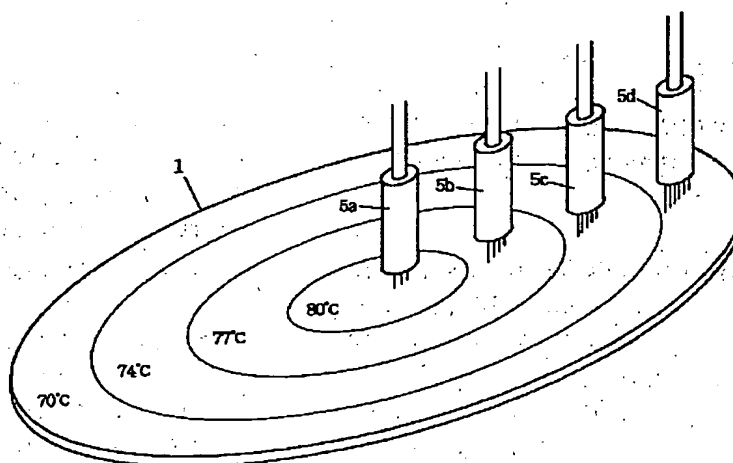
【図3】本発明の第2の実施形態に係る枚葉式基板処理装置の縦断面図である。

【図4】従来の枚葉式基板処理装置の縦断面図である。

【符号の説明】

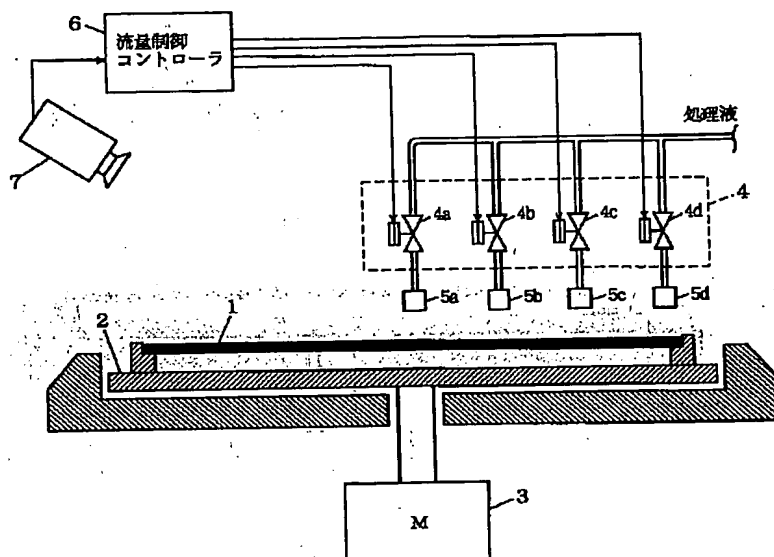
- 1…基板
- 2…スピンドル
- 3…モータ
- 4…処理液供給装置
- 4a～4h…バルブ
- 5a～5d…ノズル
- 6…流量制御コントローラ
- 7…放射温度計

【図2】

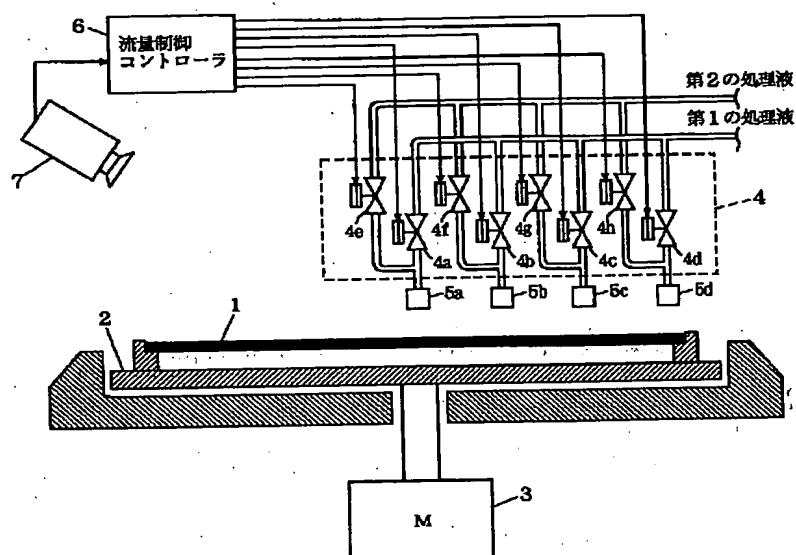


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【図1】

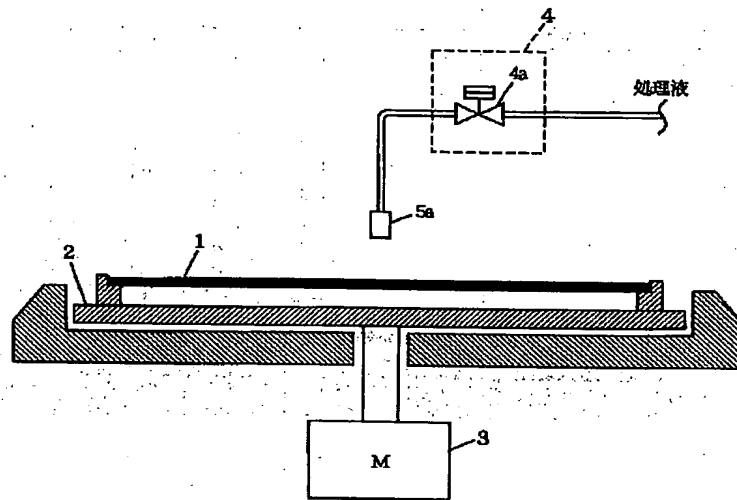


【図3】



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【図4】



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